Journal of Corporate Finance 18 (2012) 1217–1231

Contents lists available at SciVerse ScienceDirect

Journal of Corporate Finance

journal homepage: www.elsevier.com/locate/jcorpfin

Are the bankrupt skies the friendliest?☆

Federico Ciliberto [a,*], Carola Schenone [b,1]

[a] Department of Economics, University of Virginia, United States
[b] McIntire School of Commerce, Finance Area, University of Virginia, United States

ARTICLE INFO

Article history:
Received 13 August 2010
Received in revised form 12 July 2012
Accepted 17 July 2012
Available online 23 July 2012

JEL classification:
G33
L13
L93
K2

Keywords:
Bankruptcy
Chapter 11
Product market quality
Airline industry

ABSTRACT

We use data from the US airline industry to investigate whether firms that are under bankruptcy protection, as well as these firm's product market rivals, change the quality of the products they offer. We measure the quality of the services offered by a carrier using flight cancelations and delays, and the age of the aircraft used by the carrier. We find that delays and cancelations are less frequent during bankruptcy filings but return to their pre-bankruptcy levels once the bankrupt firm emerges from bankruptcy. We also find that firms use Chapter 11 filings to permanently reduce the age of their fleet. We do not find evidence of statistically and economically significant changes by the airline's competitors along any of the dimensions above.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

Partly fueled by the deteriorating credit conditions resulting from the financial turmoil that began in 2007, corporate bankruptcies in the last few years have soared. The Administrative Office of the U.S. Courts reports 12,863 Chapter 11 filings for the year ending June 30, 2009, up about 94% from the previous year when 6513 business filed for bankruptcy protection.[2] Attention has traditionally centered on the direct costs of bankruptcy proceedings, such as legal and administrative expenses, as well as their indirect costs, such as lost sales.[3] Much of the current discussion involves the effect of bankruptcy on the firm's employees who might be laid off, on the firm's suppliers who might face reduced demand, and on consumers of the bankrupt firm

☆ This paper belongs to a line of research on product market competition and bankruptcy. We benefitted from comments received in the 2010 Western Finance Association Meetings in Victoria. We also benefited from discussions with Hector Almeida, Ken Ayotte, Murillo Campello, Mike Gallmeyer, Rick Green, Barton Hamilton, Oliver Richard, David Robinson, Patrik Sandas, David C. Smith, Andrew Sweeting, and William Wilhelm. Lynn LoPucki generously shared his Bankruptcy Research Database. Schenone gratefully acknowledges financial support from the Pettit-DeMong and the Walker Fund Fellowship from the McIntire School. Evan Kwiatkowski and Huiping Cheng provided outstanding research assistance. All remaining errors are our own.

* Corresponding author. Tel.: +1 434 924 6755.
E-mail addresses: ciliberto@virginia.edu (F. Ciliberto), schenone@virginia.edu (C. Schenone).
[1] Tel.: +1 434 924 4184.

[2] Firms filing for bankruptcy protection belong to a wide range of industries, from Lehman Brothers to the Tribune Group in July and December, 2008 respectively, and Chrysler and GM in April and June 2009, respectively.

[3] Franks and Torous (1989), Thorburn (2000), Bris et al. (2006), Hennesy and Whited (2007), Bebchuk (2002).

0929-1199/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.jcorpfin.2012.07.005

who face a lower quality product or a reduction in the variety of the products offered by the bankrupt firm. Still, there is no systematic evidence showing whether or not product market *quality* changes during and after bankruptcy.[4]

We use data from the US airline industry to investigate the effect of Chapter 11 filings on the quality of the products that firms offer during a bankruptcy filing and after the firm emerges from bankruptcy protection. Using a single industry allows us to examine how bankruptcy filings affect the quality of the products while abstracting from potentially confounding unobserved differences across different industries. Thus, our analysis is in the same spirit as Chevalier (1995a,b), who studies the relationship between leverage buyouts and the pricing behavior of firms and their rivals using cross-section data from the US supermarket industry.

Several features of the airline industry make it particularly appealing to address the question of this paper. First, and foremost, there are clear and objective ways to define measures of product quality: flight cancelations, flight delays, and aircraft age, as well as oversold seats, and lost and mishandled baggage.[5] Second, there have been several bankruptcy filings in the industry over the last ten years by firms that interact with different carriers in distinct markets, and over different years. This allows us to identify the effects of bankruptcy on product quality, independent of potentially confounding market, firm, and time effects. Finally, the airline industry is an oligopoly, and hence we should expect competitors to react strategically to the choices made by bankrupt firms in the markets where these firms interact. Competitors might attempt to displace the bankrupt firm and capture the distressed firm's market share by improving product quality. However, non-bankrupt firms do not enjoy the concessions that bankruptcy grants the insolvent firm, for example, in terms of lease and labor contract renegotiations and rejections. Thus, these firms are limited in the way in which they can reorganize their business plan to respond to changes adopted by the bankrupt firm.

A non trivial part of restructuring is changing the real day-to-day operations. This in turn, has implications for the product market where the firm works. Product market effects include two distinct but related issues. First, does the bankrupt firm alter the quality of the products it offers during and after emerging from bankruptcy? Product quality is an implicit contract between customers and the firm (Maksimovic and Titman 1991), and it is one susceptible to unilateral change by the insolvent firm, as it might lower the quality to reduce costs and hence increase revenue. A second related question is whether the distressed firm will change the quantity and variety of products offered: Which operations and products will the firm continue to offer and which ones will it shed? Consistent with this quantity choice, at what price will the firm sell these products? In bankruptcy the insolvent firm can reject leases and labor contracts, granting the firm a larger leeway to modify its price and quantity business strategy, by shedding products and reducing services. This is the price and quantity question.

In this paper, we concentrate exclusively on the first question: The effects of bankruptcy on product market quality, as captured by flight cancelations, arrival delays, and age of aircrafts. We further discuss and present some evidence using baggage lost and oversold seats in a flight. Ours is the first paper to address the product-market quality implications of bankruptcy. In a companion paper, we focus exclusively on the second question and study the effects of bankruptcy filings on airline network structure, capacity choices, and ticket prices, and report that bankrupt airlines downsize their national route structure as well as their airport-specific networks; and that bankrupt airlines reduce their route-specific flight frequency and capacity. Consistently, prices are not significantly lower after bankruptcy. When dealing with quality changes, in particular arrival delays and flight cancelations, we control for the number of departed flights within markets and time period, since, as our companion paper shows, capacity shrinks during bankruptcy and this could impact delays and cancelations.

We acknowledge that changes in product market competition (both price-quantity and quality) might pre-date the actual filing, creating a potential endogeneity concern. As will be made clear in the econometric section, we deal with this following Ashenfelter (1978).

We find that an insolvent firm decreases the percent of canceled flights by 8% while it operates under protection, and increases it by 3% after emerging from bankruptcy, both numbers relative to pre-bankruptcy levels. The percentage of flights with at least a 15 min delay upon arrival drops by 9% while the carrier operates under bankruptcy protection, but returns to the pre-bankruptcy levels once the carrier emerges from bankruptcy. The age of the fleet (in years since delivery of the make/model), flown by the insolvent firm, drops 9% while the carrier operates under protection, and remains lower after the carrier emerges from protection. Overall, these results show that a firm operating in bankruptcy might be able to improve the quality of its services only temporarily and while the firm operates under bankruptcy. Once the firm emerges, the quality of daily operations returns to their pre-bankruptcy levels. The only change that appears permanent concerns the one stemming from an investment in fixed assets, the renovation of the fleet.

[4] For example, there is anecdotal evidence that during financial distress firms lower product quality to reduce production costs and increase profit margins. A famous case is that of Beech-Nut baby food products. By 1977, the company was struggling financially . At this point the firm started buying inputs from a new apple concentrate supplier, Universal Juice Co. This supplier sold its product at up to 25% below the market price. In 1979.the firm was bought by Nestle. By mid 1980, concerns were raised by research scientists suggesting that the apple juice concentrate supplied by Universal Juice Co. was adulterated. However, the new management dismissed those concerns and continued buying from Universal Juice Co. The FDA begun an investigation which revealed that the product that Beech-Nut was then marketing as 100% apple juice was actually made from beet sugar, cane sugar syrup, corn syrup and other ingredients, with little if any apple juice in the mixture. In November 1986, a federal grand jury indicted Beech-Nut and its top two executives. Prosecutors claimed that the bogus apple juice cost about 20% less to make than real apple juice. See The New York Times, November 14, 1987 and New York Times, October 31, 1993. For a brief history of Beech-Nut, see http://www.fundinguniverse.com/company-histories/BeechNut-Nutrition-Corporation-Company-History.html.

[5] We also considered baggage lost, mishandled, and/or pilfered, and oversold seats, as measures of an airline's quality of service. However, for these measures, the data available from the data is not market specific, but only carrier and year–quarter (or year–month) specific. Since the variation across markets is lost, it is not possible to identify the effect of oversales or lost baggages from confounding market effects (e.g., luggages are more likely to be lost in smaller/larger markets, etc.).

Our results are related to those in a companion paper (Ciliberto and Schenone, 2012). There we use a similar econometric methodology to the one employed in this paper, but we address a different question, we employ a different dataset, and shed light into a to study the effects of bankruptcy filings on airline network structure, capacity choices, and ticket prices. We find that bankrupt airlines downsize their national route structure as well as their airport-specific networks; and that bankrupt airlines reduce their route-specific flight frequency and capacity. We also find, somewhat surprisingly, that prices are higher after bankruptcy.

The analysis in this paper differs from the one in Ciliberto and Schenone (2012) because here we focus on the extent to which bankruptcy filings are associated with changes in the *vertical differentiation* of the airline services among firms rather than with changes in capacity and price choices. Such a clear distinction between price and quality competition is common in corporate finance and industrial organization because modeling simultaneously price and quality competition is theoretically very complex.[6] There is an additional, practical, reason why we focus on quality competition in this paper: It is extremely rare to be able to observe measures of quality, which instead we do in the airline industry. This combination of factors explains why our analysis is the first one in the literature that investigates the effect of bankruptcy filings on product quality.

The rest of the paper proceeds as follows. Section 2 gives an overview on the literature on financial distress and bankruptcy and product market competition. In Section 3 we describe specific features of the U.S. bankruptcy code that have the potential to affect product quality, and we specifically mention two sections of the Code that pertain to the airline industry. Section 4 describes the data, how we measure different dimensions of product quality, and defines the key variables in the analysis. Section 5 presents the empirical specification and Section 6 discusses the results. Section 8 concludes.

2. Literature review

There is a vast theoretical literature on the interaction between capital structure and product market competition.[7] The empirical literature has validated this link with evidence on the interaction between leverage decisions and product market prices (Chevalier, 1995a,b; Phillips, 1995; Dasgupta and Titman (1998); Pichler et al., 2008); between investment behavior and financial distress (Bhagat et al., 2005); between bankruptcy and product prices (Borenstein and Rose, 2003, and Ciliberto and Schenone, 2012); and between the announcements of bankruptcy filings and stock market performance (Ferris et al., 1997). Interest has extended beyond product market prices and has focused on how capital structure choices impact corporate performance as measured by sales (John et al., 1992; Opler and Titman, 1994; Hotchkiss, 1995; Campello, 2003, 2006), and on the interaction between capital structure and the firm's decision to enter and exit a specific product market (John et al., 1992; Kovenock and Phillips, 1995, 1997).

The theoretical literature has advanced and delved into the interaction between product market quality and capital structure. The first paper in this area is that of Titman (1984). In this work, individuals are reluctant to buy from firms that might go bankrupt because customers face a cost when the firm goes out of business. Maksimovic and Titman (1991) develop this idea further in a model where customers, even if they do not face a cost when the firm goes bankrupt, might still be averse to doing business with a highly levered firm because the financial difficulties that could arise from high leverage have detrimental effects on the firm's incentive to honor its implicit contracts. One such contract is the firm's agreement to supply high-quality products. These two papers established a potential practical link between the firm's leverage and the quality of the products or services that the firm's customers receive.

The empirical literature has yet to determine whether there is in fact an observed relationship between a firm's capital structure and the quality of its products. This paper contributes to filling this gap, by exploring the effects of a firm's bankruptcy filing on the quality of the products and services that it provides. Specifically, we disentangle the effect on the quality and variety of the products provided by a bankrupt firm and its competitors, both during and after bankruptcy.

Exploring the actual link between bankruptcy and product quality unveils a real cost of bankruptcy to the customers of the insolvent firm which has so far remained vastly unexplored in the financial literature. Analysis of the costs of bankruptcy has focused on the direct and indirect costs.[8] Direct costs include bankruptcy proceeding fees, such as court and lawyer expenses, as well as fees paid to accountants and expert witnesses. Indirect costs include the change in the value of the estate during the bankruptcy process, as well as the time the firm spends under bankruptcy protection. The latter has been used to proxy for a bankruptcy's adverse impact on product markets *as well as* the capital markets (Franks and Torous, 1989, and Thorburn, 2000). As Bris et al. (2006) claim, this is a very noisy proxy for the indirect costs of bankruptcy, adding to the controversy over the magnitude of indirect bankruptcy costs. By precisely measuring the effects of bankruptcy on *product market quality*, we can cleanly measure one way in which a firm's insolvency can have an adverse effect on the firm's customers, thus allowing us to precisely measure a bankruptcy's adverse impact on the product market.

[6] For example, see Tirole (1988).

[7] See for instance, Titman (1984), Brander and Lewis (1986), Benoît (1985), Maksimovic (1988), Chevalier and Scharfstein (1995), and Dasgupta and Titman (1998).

[8] Recently, there has been extended research comparing auctions against a reorganization-based bankruptcy system such as Chapter 11. See Hotchkiss and Mooradian, 2003, and Eckbo and Throburn, 2009.

Table 1
Stylized facts. Bankruptcies in the Airline Industry between 1992 and 2007. Airline Bankruptcies are identified from the Air and Transportation Association (ATA), and cross checked with the Bankruptcy Research Database from Professor Lynn LoPucki. The remaining information is from news searches in Lexis-Nexus and Factiva. Of course, only a few articles are cited (those closest to the filing date, or the most relevant ones). These are just examples that illustrate how carriers downsize taking advantage of the Chapter 11 allowances, and how this, in turn, affects the variety and quality of services offered.

Airline	Filed	Emerged	Days	Layoffs	Leases	Routes
United	12/9/2002	2/2/2006	1133	By 12/23/2002, had laid off 646 mechanics due to decrease in flight schedule (WSJ, 12/23/2002)	By May 03 UAL had renegotiated leases on 51 GE planes (Bloomberg, 5/24/2003)	Did not cut routes initially however, did decrease flights by 8% and then 4%. (WSJ 4/16/03)
USAir	8/11/2002	3/31/2003	230	By 8/22/02, 250 pilots had been laid off, and 1070 employees furloughed (SPI, 8/22/02)	"A U.S. bankruptcy-court judge has given US Airways relief from making any further payments on 57 aging jetliners it had parked in the desert after Sept. 11. All of those are likely to be returned to their owners, who will then face the daunting task of finding new homes for them." (WSJ, 8/14/2002).	Reduce the daily flight schedule to 1350 from 1550 flights. (WSJ, 8/22/02). Planed to reduce mainline jet service 13% by end of 2002 (SPI, 8/22/02). Eliminate about 300 weekday flights by Nov. 2, but bulk up its schedule on key business routes. By September 3, 2002, most changes involve fewer frequencies and shifts from big jets to smaller planes rather than total elimination of service. Service in 71 cities unchanged, 26 cities will have more flight seats. Non-stop flights eliminated on about 36 routes. Flights cut at most of its hubs (Charlotte, Pittsburgh, Philadelphia and Boston Logan), but grow 7% at LaGuardia and 1% a t Reagan Washington National. Flights on small regional jets increase 4%, on large jets will decrease 13%, and fall by 7% on turboprops. (USA, 9/3/2002)
USAir	9/12/2004	9/27/2005	375	By October 2004, the bankruptcy court judge in October approved a 21% pay cut for most workers through February (WP, 12/2/2004)	By November 2004, US Air agreed with General Electric Co. to defer lease payments on some aircraft and cut engine maintenance cost. The deal also calls for GE Capital Aviation to lease 31 new 70- and 90-seat regional jets to the airline in the next 3 years and for the airline to return 25 of its larger aircraft. (WP, 11/27/2004). US Airways agreed to return 10 Airbus A319s by 2005, and 15 older Boeing 737s to GE in 2006 and 2007, (WSJ, 11/26/2004). Starting May 2005, ground and return 11 planes to leasing company (WSJ, 2/28/05)	

Northwest	9/14/2005	5/18/2007	611	Lay off 1400 flight attendants by the end of 2005 (WSJ, 9/21/05). By 10/31/05, 900 furloughs, including 480 in Detroit and 355 in Minneapolis, two large NW hubs. By 9/21/2005, 500 pilots were laid off given the plan to reduce the number of hours its mainline fleet operates by 13% (WSJ, 9/21/2005). By 10/13/2005, 4400 machinists and related employees where replaced by "cheaper workers and outside vendors" (NYT 10/13/2005)	13 planes in a fleet of 433 aircrafts returned to lessor, and many more aircrafts have the potential to be rejected. By 9/26/2006, all 35 jet leases with Mesaba terminated (WSJ, 9/26/2005). On 2/1/2006, the bankruptcy judge allowed NW request to lower lease and loan payment for aircrafts (WSJ, 2/1/06)	In filing, NW announced cut in domestic mainline capacity by 9 to 10% (and international by 4 to 5%) (NYT 10/13/05). By fourth quarter 2005, mainline capacity was down 7 to 8% from previous year.
Delta	9/14/2005	4/25/2007	563	By 9/23/2005, announced plans to cut 9000 jobs (USA, 9/23/05)	By 1/26/06, DL had cancelled the lease on the north-side hangar in its primary hub, Hartsfield Jackson airport. (AJC, 1/26/06)	In filing, DL pans to reconfigure its fleet and network, retiring 4 of 11 aircraft types, purpose of such restructuring involves shrinking capacity. By 9/23/2005, announced a reduction in domestic flights of 20% by downsizing hubs Atlanta, Cincinnati, and Salt Lake City. (USA, 9/23/05)
ATA Airlines	10/26/2004	2/28/2006	490	By July 05, ATA cut 450 workers (300 mechanics and 100 reservations personnel) (WSJ, 7/18/2005)	Upon filing, ATA reached a deal to give over its gate leases, slots and routes out of Chicago's Midway airport, New York's LaGuardia, and Washington National airports (WSJ 10/26/04). ATA Holdings Corp.'s ATA Airlines gave GE the chance to take back 18 plan es that deployed in places such as China, Brazil and India. (WSJ, 3/31/2005)	ATA cut its Chicago fleet to 50 aircraft from 60 (DOW, 12/16/05). "ATA Airlines, once the busiest carrier in Indianapolis but shrinking during bankruptcy proceedings in the last y ear, said yesterday that it would cancel its last three daily flights out of the city, which is its headquarters, as of Jan. 10" NYT, 11/2/2005)

Key to the Sources: NYT = New York Times; WSJ = Wall Street Journal; AJC = Atlanta Journal Constitution; SPI = Seattle Post-Intelligencer; USA = USA Today.

3. Bankruptcy in the airline industry

The United States Bankruptcy Code contemplates two alternative solutions for firms that are in financial distress and are filing for court protection: Chapter 7 (Liquidation) and Chapter 11 (Reorganization). Chapter 7 allows for an orderly, court-supervised procedure by which a trustee collects the assets of the firm, reduces them to cash, and makes distributions to creditors subject to the debtor's right to retain certain exempt property and to the rights of secured creditors. Chapter 11 allows the bankrupt firm to continue operating while the firm's management restructures its business. We focus on Chapter 11 filings and drop firms filing under Chapter 7 because we are interested in the changes in the variety and quality of the services provided by a firm that operates under bankruptcy protection, and firms filing for Chapter 7 cease operations and liquidate their assets.[9]

A firm operating under bankruptcy protection can benefit from provisions granted by the United States Bankruptcy Law, such as creditor protection and greater flexibility to renegotiate and rescind contracts. For instance, under Section 1113 of Chapter 11, an airline can unilaterally modify labor agreements if negotiations with employees and labor unions are unsuccessful, and can terminate labor contracts it deems no longer needed. And under Section 1110 of Chapter 11, the bankrupt firm can selectively reject leases on aircrafts and freely return unwanted and outdated aircrafts to the lessor. These concessions allow the firm to downsize, reduce capacity, and reduce the variety of products offered shifting from the least profitable ones to the most profitable ones, at a lower cost than what would have to be borne outside of bankruptcy. As a consequence of this, the firm frees funds that might be reallocated to improving the quality of the products that the firm continues to offer. Table 1 presents some stylized facts concerning the quality of service during the most relevant bankruptcies in the airline industry between 1992 and 2007.

3.1. Rescinding leases

Rejecting leases on selected aircrafts frees up funds that allow the carrier to reorganize its fleet and to replace older aircrafts with newer, more comfortable, and higher quality ones. Rescinding leases on airport facilities, such as gates and hangars, can also free up funds so that the carrier can acquire 'better' gates that increase the efficiency with which the carrier can turn around the plane for the next flight, and lowering departure and arrival delays. In sum, rejecting leases on aircrafts and gates lowers the cost of reducing service (frequency and markets served), but can allow an increase in the quality of the services that the carrier still provides.

3.2. Rescinding labor contracts

Rejecting labor contracts can have an ambiguous effect on the quality of services. If layoffs result in a smaller workforce than needed to efficiently perform the daily operations of the firm, the carrier's quality of service drops. But if layoffs allow the firm to replace entrenched and inefficient personnel with a more efficient workforce, service quality increases. For instance, laying off necessary gate agents and aircraft cleaning crews can delay the process of boarding a flight, thus resulting in longer departure and arrival delays for the late-in-boarding flight as well as for the flight that is incoming to that gate. On the other hand, if the laid-off gate agents were unnecessary for the firm's operations, or were entrenched and inefficient employees that can now be replaced with more efficient ones, then there might be some improvement (or no effect) in product quality.

4. Data description

Our data are an original compilation from several sources. From the Air Transportation Association Web site, Lynn LoPucki's Bankruptcy Database, and Factiva and Lexis-Nexis reports, we obtain the identity of carriers filing for bankruptcy, the dates on which each carrier entered and exited court protection, and the specific way in which each carrier emerged from protection.[10] We merge this dataset with the data on product quality gathered from several original sources: the "On-Time Performance Schedule" gathered by the Bureau of Transportation Statistics (BTS); the T-100 Domestic Segment of Form 41 reported by the BTS; the web sites of aircraft producers (e.g., Boeing or Airbus); "The International Directory of Civil Aircraft"; and the "Aviation Consumer Protection Division" (ACPD) of the Department of Transportation (DOT). Table 2 describes the data sources, the units of observation, and other characteristics in each dataset. Table 3 provides summary statistics.

Carrier definition. We consider nine national carriers operating between 1997 and 2007: American, Continental, Delta, America West (until the third quarter of 2005), Northwest, TWA (until the second quarter of 2001), United, US Airways, and Southwest. We also consider two low-cost carriers that had a strong presence during this period, Airtran and ATA. We group the remaining low cost carriers into one category, LCC. The carriers in this category are: Aloha Airlines, Alaska Airlines, Jet Blue, Independence Air, Frontier Airlines, Florida Airlines, and YZ: $LCC = \{AQ, AS, B6, DH, F9, FL, YV\}$. For each route–year–quarter, we take the averages across the low-cost carriers for the control variables. Grouping low-cost carriers in one category allows us to keep small carriers that are present in only a few markets or for a few quarters when we include route–carrier fixed effects. Furthermore, it allows us to use a meaningful grouping, capturing the impact of small carriers' presence in the market.

[9] For a more detailed description of the institutional details associated with bankruptcy filings in the airline industry, see Ciliberto and Schenone (2012) and references therein.

[10] The Bankruptcy Research Database compiled by Law Professor Lynn LoPucki includes all Chapter 11 bankruptcy cases that satisfy the following two requirements. First, the debtor group filing for Chapter 11 protection must have assets worth at least $100 million at the time of filing (measured in 1980 dollars), as listed in the last 10-K filed before bankruptcy (provided that the 10-K is for a year ending within three years prior to filing for bankruptcy). Second, the debtor group is required to file 10-Ks with the SEC. For airlines satisfying these requirements, we double check the filing dates, the type of filing, and the date of emergence where available.

Table 2
Data description.

Data	On time performance	Scheduling data	Aircraft characteristics
Frequency	By carrier, year, quarter (since 1993)	By carrier, year, quarter (since 1993)	For the make and model reported in the scheduling data
Market Specific?	Yes	Yes	No
Data Collected	On-time departure and arrival.	Aircraft configuration Aircraft group (prop, turbo prop, 2, 3, 4, or 6 engines) Aircraft type (make and model).	Year first ordered, year first flown, first and last delivery year.
Source	The "On-Time Performance" schedule gathered by the Bureau of Transportation Statistics (BTS)	The T-100 Domestic Segment of Form 41 reported by the BTS	Each aircraft producer's website. Complemented with data from airliners.net, and data from "The International Directory of Civil Aircraft"
Database	Monthly data reported by US certified air carriers that account for at least one percent of domestic scheduled passenger revenues.		"The International Directory of Civil Aircraft" contains detailed information on each aircrafts characteristics and history.

Route definition. We define a route, denoted by r, as a *non-stop* airport-to-airport trip. We consider all airport-to-airport pairs between the top 50 Metropolitan Statistical Areas (MSAs), ranked by population size. Here a route is also a market, and we refer to them interchangeably.

Bankrupt carriers. We identify airlines that have filed for bankruptcy protection between 1997 and 2007 from the Air Transportation Association Website, which provides a list of the names of air carriers that have filed for bankruptcy protection, the date of the bankruptcy filing, and the type of protection requested by the airline (Chapter 11 or Chapter 7). We cross check this data with the Bankruptcy Research Database, compiled by Lynn LoPucki. There are six carriers operating under bankruptcy protection during our sample period: United Airlines (December 9, 2002 through February 2, 2006), US Airways (August 11, 2002 through March 31, 2003 and then again September 12, 2004 through September 27, 2005), ATA (October 26, 2004 through February 28, 2006), Delta (September 14, 2005 through May 1, 2007), and Northwest (September 14, 2005 through May 31, 2007). Some small carriers operated under court protection for a small time window, and thus we cannot consider these carriers independently (e.g., Independence Air operated under court protection between November 7, 2005 and January 5, 2006).[11]

Unit of observation. The unit of observation is a carrier–route–year–quarter. We denote time periods by $t = 1, \ldots T$. For example, the combination jrt indicates that airline j (e.g. American) transports its passengers on route r (Chicago O'Hare to Fort Lauderdale Airport) at time t (e.g. the second quarter of 2002). Note that an important reason for using the airline industry for our analysis is that airlines compete over many different routes and markets, and over different time periods. Furthermore, a carrier's competitors at any given point in time, in one route, might not be the same competitors in a different route at that same time. For example, United Airline's competitors in Denver–San Francisco in the first quarter of 2001 are not the same set of competitors United faces in the route between Dallas Forth Worth and Newark in the first quarter of 2001. Thus, a carrier's business strategy in one route might differ from its strategy on a different route. Therefore, even though we have six different bankrupt carriers in the national domestic market, the strategic decision a carrier makes in one route can differ from the one taken in a different route. This allows us to span the effective number of firms (bankrupt and not bankrupt).[12]

4.1. Bankruptcy categorical variables

Several factors that can alter the competitive interaction between firms in an industry come into play when one of the firms in the industry reorganizes under Chapter 11. First, the bankrupt firm faces cost shocks inherent to operating under court protection, such as the ability to renege and renegotiate contracts. At the same time, the bankrupt firm faces demand shocks stemming from loss of consumer confidence, which reduce demand for its products (Opler and Titman, 1994).

We cannot capture cost related shocks using accounting data on costs because these report exactly those liabilities which are renegotiated under bankruptcy, and hence do not reveal exogenous cost shocks. Demand shocks are not observable. Therefore, to capture all of these changes we use *bankruptcy categorical variables*. Below we summarize the information used to derive and construct these categorical variables.

We define the set K of carriers that filed for bankruptcy protection at some point between 1997 and 2007 as $K = \{UA, US(1^{st}), US(2^{nd}), NW, DL, TZ\}$. Notice that US Airways filed for Chapter 11 twice.[13] In the rest of the paper, we will use the

[11] We exclude TWA's third bankruptcy even though it occurred during our sample period because the firm stayed under bankruptcy protection for less than one quarter. Furthermore, because we include route–carrier and year–quarter fixed effects, this bankruptcy would be dropped in the econometric analysis. For an analysis of prepackaged bankruptcies, see Carapeto, 2005.

[12] In fact, the literature on the airline industry (see for example, Berry (1990), Borenstein (1989), Brueckner et al. (1992), Berry and Jia (2010), and Gerardi and Shapiro (2009)) assume that carriers make decisions that are route specific as opposed to making nation wide decisions.

[13] During our analysis period, TWA filed for bankruptcy for the third time. This filing lasted for less than one quarter. Because of its brevity and because we include route–carrier and year–quarter fixed effects, we do not include it in the analysis.

Table 3
Summary statistics for the market competition variables.

	Mean	S.D.
Delays	58.077	56.038
Number of departed flights that were more than 15 min late in a quarter		
Canceled flights	8.377	17.404
Number of scheduled flights that were canceled in a quarter		
Age aircraft	20.465	8.343
Number of years since year of first delivery of the plane		
Scheduled flights	337.474	292.035
Departed flights	292.355	260.30
Number of observations	175,692	

subscript $k = 1,\ldots,K$ to denote a bankrupt firm (where K is equal to 6). Next, we discuss the variables that measure the effect of bankruptcy protection during and after the time when the firm is under Chapter 11.

During the bankruptcy filing. We want to distinguish the effect that bankruptcy filings have on the quality measures we consider, for the bankrupt firm, and for its competitors, during the time when the bankrupt firm operates under Chapter 11, as well as after the firm emerges from bankruptcy protection. To measure these effects, we construct the following categorical variables. First, we define Bkt_{rt} equal to 1 if there is at least one carrier under bankruptcy protection at time t and that carrier provides service on route r, otherwise, Bkt_{rt} is equal to zero. For each quality measure, we study the average effect of bankruptcy across markets and across bankrupt and non-bankrupt carriers.

After the emergence from bankruptcy. Next, we ask whether any observed price changes during bankruptcy persist once the bankrupt firm emerges from court protection. To do this, we define the categorical variable $AftBkt_{rt}$ equal to 1 if there is at least one carrier that was under bankruptcy protection at a time before t, and that carrier currently serves route r. Otherwise, $AftBkt_{rt}$ is equal to zero.

Active firm categorical variables. The presence of a bankrupt carrier in a route could affect the behavior of all other carriers in that market, regardless of whether or not that carrier is under Chapter 11 protection. Without controlling for the presence of a carrier that is bankrupt at some point in time, we cannot identify the effect of a firm k's filing for bankruptcy protection separately from the average effect of that carrier k's presence. We address this problem with categorical variables that capture whether a bankrupt or a to-be-bankrupt firm is in the market: In_{rt} is equal to 1 if at least one bankrupt firm k is present in route r at time t.

4.2. Quality of products

In this paper we consider three measures that identify the quality of airline service: arrival delays, flight cancelations, and aircraft age.[14] There are other measures of airline quality of service, such as lost, pilfered and mishandled baggages and oversold flights, that we do not employ in the econometric analysis, since this data is carrier–year–quarter specific and lacks the market dimension. Such lack of market specific variation reduces the identification power of econometric estimates. This will be discussed in further detail following the discussion on the results we obtain for delays, flight cancelations, and aircraft age.

Flight delays. We begin our study with an analysis of flight delays.[15] Data on flight delays are from the "On-Time Performance" schedule gathered by the Bureau of Transportation Statistics (BTS). Delays correspond to delays for reasons within the carrier's control, as well as those beyond its control. If one thought that any effect on delays observed during bankruptcy is related to reasons beyond the carrier's control, such as weather delays, then the distribution of bad weather in a market over time has to coincide with the times when there is a bankrupt carrier operating in that market (this is, weather should always be worse for flying during the times when some carrier is bankrupt). This is highly unlikely. [16] Arrival delays are calculated as the difference between the scheduled and the actual arrival times. $Delay_{jrt}$ measures for every carrier j, flying route r, during year-quarter t, the number of times that the carrier's flights are at least 15 min late upon arrival.[17] Table 3 shows that on average, across markets and carriers, there are 58 flights per quarter that are at least 15 min late. Note that there are on average, across carriers and markets, 337 flights scheduled and 292 flight departures, in a quarter.[18]

[14] There is a rich literature that studies the quality of airline service. Work by Bowen and Headley (1997), Gourdin (1988), and Elliott and Roach (1993) considered as measures of airline service quality the average age of the fleet, the number of aircrafts, the percent of delayed arrivals and departures, the number of canceled and diverted flights.

[15] Previous works have looked at the relationship between flight delays and the following variables: competition (Rupp et al., 2006, market concentration (Mazzeo, 2003), aircraft capacity utilization (Ramdas and Williams, 2011), airport congestion (Mayer and Todd, 2003), stock price movements (Li, Lipson, Ramdas, and Williams, 2011).

[16] Data on delays that are within the carrier's control is available only after June 2003. This restricts the sample period and excludes the first bankruptcy filing by US Airways, as well as the beginning of United Airlines' bankruptcy. We estimate regressions using both measures of delays and, not surprisingly, find that the results are statistically and economically similar.

[17] We only look at route–carrier–year–quarter observations for which we know that a carrier had at least 50 departed flights. This means that a carrier had to serve a route at least for a month and a half with at least one flight per day.

[18] We do not have reasons to worry about any bias induced by left-censoring, since only 0.17 percent of the route–carrier–year–quarter observations do not have even one flight that was delayed at least 15 min (the number of zeros in the variable $Delay_{jrt}$ over the total number of observations in a route, by a carrier, in a year quarter is 0.17).

Table 4
The effect of bankruptcy filings on delays. The dependent variable is a natural logarithm of the total number of times that carrier *j*, flying in route *r*, during the year quarter *t*, arrived at the destination at least 15 min late. Arrival delays are the difference between scheduled and actual arrival times. *Actual arrival* time is defined as "The time the aircraft touches down upon arrival"; and scheduled arrival is defined as "The scheduled time that an aircraft should cross a certain point (landing or metering fix)." Arrival delays do not include taxi in times.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	During	After	During	After	During	After	During	After	During	After
Effect on bankrupt firm	−0.09***	0.00*	0.02***	0.21***	0.03***	0.21***	0.05***	0.21***	0.05***	0.22***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Effect on rivals	0.01**	0.04***	0.07***	0.24***	0.07***	0.20***	0.07***	0.21***	0.08***	0.20***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of departed flights	1.04***		1.09***		1.09***		1.09***		1.07***	
	(0.00)		(0.00)		(0.00)		(0.00)		(0.00)	
Constant	−1.78***		−2.44***		−2.39***		−2.36***		−2.24***	
	(0.16)		(0.02)		(0.02)		(0.02)		(0.02)	
Observations	139,424		139,424		139,424		145,246		145,246	
Route–carriers	6114		6114		6114		6127		6127	
Fixed/random effects	FE		FE		FE		FE		RE	
Exclude 2 quarters	Yes		Yes		Yes		No		No	
Time trends	Yes		Yes		No		No		No	
Year–quarter FE	Yes		No		No		No		No	
Adj. R-squared	0.84		0.80		0.80		0.79			

Standard errors in parentheses.
*** p<0.01.
** p<0.05.
* p<0.1.

Flight cancelations. Next, we consider flight cancelations as measure of quality of service. Data on canceled flights are from the "On-Time Performance" schedule. $Cancelled_{jrt}$ is the total number of times that carrier *j* canceled a flight on route *r* during the year–quarter *t*.[19] A flight is considered canceled by the BTS when it is listed in a carrier's computer reservation system during the seven calendar days prior to its scheduled departure but the flight was not operated and did not depart.[20] Table 3 shows that on average there are 8.377 flights per quarter that are canceled. Notice that 23.32% of the route–carrier–year–quarter observations do not have even one flight that was canceled. In this case, there is reason to be worried about any bias induced by left–censoring. We will show the results when we run a random effect tobit regressions and compare them with the results when we run a standard linear random effects regression. The results are identical, suggesting that in practice, left censoring is not an issue for the analysis of this variable.[21]

Aircraft age. The age of a specific aircraft, the overall condition of its cabin, and its safety record are another measure of the quality of airline service. Older planes have been reported to be less comfortable in terms of space, noise emission, cabin pressure, and entertainment opportunities.[22] We use the T-100 Domestic Segment Database of Form 41 reported by the BTS to collect data on the specific aircraft type, make, and model that is flown by carrier *j* on route *r* during year–quarter *t*. We gather the date when each specific aircraft type was first delivered by the producer using data from the aircraft producer's Web site. Missing data in the aircraft producers Web site is completed using "The International Directory of Civil Aircraft."[23] We compute the time span between the year when an aircraft of a particular make and model was used on route *r* by carrier *j*, and the year when that particular aircraft make and model was first delivered for commercial flight. We denote this variable with $AgeAircraft_{jrt}$.[24] Table 3 shows that on average planes are 20.46 years old. Notice that only 0.03% of the route–carrier–year–quarter observations have a plane that is less than 1 year old, so there is no reason to be worried about any bias induced by left-censoring.

5. Empirical specification

We estimate regressions of these measures of variety and quality of service on two sets of bankruptcy related categorical variables. The first indicates whether a competitor in a market *currently operates* under bankruptcy protection (Bkt_{rt}^{Own} for the effect of the bankrupt firm, and Bkt_{rt}^{Others} for the effect on competitors). The second indicates whether any of the firms competing in a market previously operated under bankruptcy ($AftBkt_{rt}^{Own}$ for the effect of the ex-bankrupt firm, and $AftBkt_{rt}^{Others}$ for the effect of the competitors of the ex-bankrupt firm). The latter allows us to distinguish whether the effects of bankruptcy on the variety and quality of an airline's service are temporary or whether they persist after the insolvent firm exits bankruptcy. All of our

[19] For a study on the determinants of flight cancelations, see Holmes and Rupp, 2006.
[20] We only look at route–carrier–year–quarter observations for which we know that a carrier had at least 50 scheduled flights. This means that a carrier had to have a scheduled flight in a route at least for a month and a half with at least one flight per day.
[21] Table 5, Columns 11 and 12.
[22] For example, in Jet Blue's fleet of Embraers each seat is equipped with a monitor where passengers can watch popular TV shows and live news updates.
[23] In very few cases we used information from www.airliners.net.
[24] Occasionally, carrier *j* flying route *r* during year–quarter *t* uses more than one aircraft type. In these cases, we choose the oldest plane.

Table 5
The effect of bankruptcy filings on canceled flights. The dependent variable is the natural logarithm of the total number of times that carrier *j*, canceled a flight in route *r*, during the year quarter *t*. A flight is considered canceled by the BTS when it is listed in a carrier's computer reservation system during the seven calendar days prior to its scheduled departure but the flight was not operated and did not depart.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	During	After	During	After	During	After	During	After	During	After	During	After
Effect on bankrupt firm	−0.08***	0.03**	−0.16***	−0.08***	−0.26***	−0.21***	−0.22***	−0.17***	−0.20***	−0.16***	−0.20***	−0.16***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Effect on rivals	−0.04***	0.02*	−0.13***	−0.03**	−0.21***	−0.14***	−0.18***	−0.11***	−0.19***	−0.13***	−0.19***	−0.13***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Number of scheduled flights	0.89***		0.93***		0.95***		0.94***		0.92***		0.92***	
	(0.01)		(0.01)		(0.01)		(0.01)		(0.01)		(0.01)	
Constant	−3.35***		−3.69***		−3.84***		−3.84***		−3.60***		−3.60***	
	(0.04)		(0.04)		(0.04)		(0.04)		(0.03)		(0.03)	
Observations	143,267		143,267		143,267		149,229		149,229		149,229	
Route–carriers	6286		6286		6286		6302		6302		6302	
Random effects	No		No		No		No		Yes		Yes	
Fixed/random effects	FE		FE		FE		FE		RE		RE	
Exclude 2 quarters	Yes		Yes		Yes		No		No		No	
Time trends	Yes		Yes		No		No		No		No	
Year–quarter FE	Yes		No		No		No		No		No	
Tobit (left censoring at 0)	No		No		No		No		No		Yes	
Adj. R-squared	0.71		0.63		0.62		0.62					
Log likelihood											−172435.28	

Standard errors in parentheses.
*** p<0.01.
** p<0.05.
* p<0.1.

specifications control for heterogeneity across carriers and airline routes with route–carrier fixed effects. To control for possible time shocks, we include year–quarter dummies.

We develop a simple econometric specification that captures the in-bankruptcy and post-bankruptcy effects of a firm's Chapter 11 filing on the quality of the products offered by the bankrupt firm and by this firm's competitors:

$$\ln Q_{jrt} = \alpha^{OWN} Bkt_{rt}^{Own} + \alpha^{OTH} Bkt_{rt}^{Others} + \beta^{OWN} AftBkt_{rt}^{Own} + \beta^{OTH} AftBkt_{rt}^{Others} + \varepsilon_{jgt}, \quad (1)$$

where ε_{jrt} is the remaining component of the regression to be discussed in detail below. Here, Q_{jrt} is one of the measures discussed in Section 2: $Delay_{jrt}$, $Cancelled_{jrt}$, and $AgeAircraft_{jrt}$. The coefficient α^{OWN} measures the current effect of a bankruptcy filing on the bankrupt firm's variable Q_{jgt}, while α^{OTH} measures the current effect on the bankrupt's firm competitors. The post-bankruptcy effects are measured by β^{OWN} and β^{OTHER}, for the bankrupt firm and its competitors, respectively.

Let ε_{jgt} be defined as follows:

$$\varepsilon_{jrt} = \gamma In_{rt} + \theta_{o(r)} Origin_{rt} \cdot Trend_t + \theta_{d(r)} Dest_{rt} \cdot Trend_t + u_{jr} + u_t + u_{jrt}. \quad (2)$$

The first component of ε_{jgt} is the variable that controls for whether one of the firms that is filing for bankruptcy operates in route *r* at any point in time, In_{rt}. It is likely that this variable is a function of the same unobservable that affect the carrier's quality choices, introducing sample selection concerns. Route–carrier fixed effects, u_{jr}, control for this type of selection (Veerbek and Nijman, 1992). Route–carrier fixed effects also control for route–carrier sources of heterogeneity. The idiosyncractic carrier–route–year–quarter unobservable is captured by u_{jrt}. The term u_t represents year–quarter fixed effects that capture quality changes triggered by demand changes stemming from seasonal (or other exogenous time varying) shocks, such as weather variation, high/low travel season, and increases in the cost of fuel. This also captures any serially correlated industry-specific shock to demand. Finally, we account for the possibility of persistent correlation between negative unobserved current and expected demand shifts (that extend beyond the pre-bankruptcy period which we eliminate) in markets served by the bankrupt airlines relative to that found in markets served by other airlines. To deal with such market-specific unobservable correlations across time, we follow Friedberg (1998), and include linear market time trends. The variable $Trend_t$ is a time trend. Finally, $\theta_{o(r)}$ is the parameter of the origin-specific time trend, where *o* is the origin airport of route *r*. Similarly, $\theta_{d(r)}$ is the parameter of the destination-specific time trend.

In the time period immediately proceeding the bankruptcy filing, the insolvent firm might take actions to avoid bankruptcy that it would not otherwise take. One such action could be to attempt to increase profit margins by reducing the quality of the

Table 6
The effect of bankruptcy filings on the age of planes. The dependent variable is the natural logarithm of the number of years since the aircraft's (make and model) first delivery: Data on the year a specific aircraft type (make and model) was first delivered by the aircraft's producer is from Aircraft producer's website, airliners.net, "The International Directory of Civil Aircraft".

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	During	After	During	After	During	After	During	After	During	After
Effect on bankrupt firm	−0.09***	−0.09***	−0.07***	−0.01*	−0.08***	−0.06***	−0.08***	−0.06***	−0.08***	−0.05***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Effect on rivals	0.02***	0.01**	0.03***	0.09***	0.03***	0.09***	0.03***	0.09***	0.02***	0.08***
	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)	(0.00)	(0.01)
Constant	3.69***		2.90***		2.91***		2.91***		2.80***	
	(0.17)		(0.00)		(0.00)		(0.00)		(0.01)	
Observations	175,692		175,692		175,692		175,692		175,692	
Route–carriers	8604		8604		8604		8604		8604	
Fixed/random effects	FE		FE		FE		FE		RE	
Exclude 2 quarters	Yes		Yes		Yes		No		No	
Time trends	Yes		Yes		No		No		No	
Year–quarter FE	Yes		No		No		No		No	
Adj. R-squared	0.71		0.70		0.69		0.69			

Standard errors in parentheses.
*** p<0.01.
** p<0.05.
* p<0.1.

products offered (under the assumption that lower quality products can be produced at a lower price). If this were the case, the bankruptcy indicator variables in our quality equations would be endogenous.[25] To deal with such unobservable that are correlated with pre-bankruptcy quality and with the firm's bankruptcy filing, we follow the strategy used by Ashenfelter (1978). In this work, Ashenfelter noted that all trainees suffered unexpected earning declines in the year prior to entering a training program (see Ashenfelter (1978, page 51)). Therefore simple comparisons of earnings before and after the training program would be misleading evidence of the effect of training on earnings. To deal with this, Ashenfelter dropped the period immediately preceding training (see Ashenfelter (1978, page 53)). In our case, a comparison of pre- and post-bankruptcy quality levels would yield a dampened effect of bankruptcy on product quality. We follow Ashenfelter's strategy and exclude the 2 quarters preceding bankruptcy.

In a related work, Ciliberto and Schenone (2012) show that during bankruptcy, the distressed carrier's lower capacity, and reduce the number of national routes served, the airport-specific route network (i.e., the number of flights served out of an airport), as well as lowering the frequency of flights in a given route (the number of flights offered in a given route during a year–quarter). Such downsizing can affect the carrier's on time performance and its cancelation policy: with fewer flights serving a market, it might be easier to reduce arrival delays and canceling flights might be a less attractive option. Therefore, if we observed fewer arrival delays and fewer cancelations, this could be not due to an improvement in quality per se, but to a lower frequency of flights and a reduced capacity. To disentangle this capacity effect from the bankruptcy effect, we include the log of the number of departed flights by carrier j, in route r, at time t, $Log(Departed\ Flights_{jrt})$ and the log of the number of cancelations. If there is a change in arrival delays (or in cancelations) due to the reduced service provided by the carrier, then these variables will capture this effect and the bankruptcy variables will be clean of the reduced service effect.

In order to interpret the coefficients of the dummy variables in the semilogarithmic regression equation above we need to transform the estimates. This is because in a semilog regression the coefficient of a dummy variable, multiplied by 100, is *not* equal to the percentage effect of that variable on the variable being explained. Halvorsen and Palmquist (1980) show that to give the estimated coefficient a percentage interpretation, we need to transform the coefficient as follows. If the estimated coefficient is $\hat{\alpha}^{OWN}$ then the percentage effect of Bkt_{rt}^{Own} on Q_{jrt} is $\tilde{\alpha}^{OWN} = exp\left(\hat{\alpha}^{OWN}\right) - 1$.

6. Results

Here we discuss the results concerning the effect of bankruptcy on the *quality* of the products that the firm offers.

Arrival delays. In Table 4, the dependent variable is the natural logarithm of arrival delays of at least 15 min. Note that in all of these regressions we also include the natural logarithm of the number of departed flights, $Log(Departed\ Flight_{sjrt})$. Note that these are *not scheduled* flights, but the actual number of flights flown by carrier j, in route r, during year–quarter t. This variable will absorb any effect on arrival delays that might arise from a change in carrier j's capacity, thus disentangling the effect on delays of capacity reduction from the effect of change in the bankrupt firm's operations.

Columns 1 and 2 report that the percentage of flights arriving at least 15 min late for the bankrupt carrier falls by 9% while the firm operates under court protection, but returns to its pre-bankruptcy level after the firm emerges from protection. Competitors,

[25] Recall the example of Beech-Nut during the mid 1980s. The firm was struggling financially, and to keep the firm from insolvency, management decided to knowingly continue buying adulterated juice from Universal Juice Co. since this was 20% less expensive than real apple juice.

instead, do not exhibit any change in the percentage of such arrival delays, although upon the bankrupt firm's emergence from protection their arrival delays increase by about 4%. These results are obtained when excluding the 2 quarters prior to bankruptcy, and including route–carrier fixed effects, year–quarter fixed effects, and origin and destination time trends.

Comparing these results with those in Columns 3 through 10 reveals the importance of controlling for these unobservables. Specifically, when we exclude year–quarter fixed effects (Columns 3 through 10) we find that the percentage of arrival delays longer than 15 min increases rather than decreases both during and after bankruptcy, and for both the insolvent firm and its competitors. This indicates that arrival delays have changed over time, and therefore ignoring these time effects results in biased estimates that confound the effect of bankruptcy on arrival delays.

In Columns 5 and 6 we exclude the origin and destination time trends, and find that these controls are important for identifying the effect of bankruptcy on delays. Columns 7 and 8 add back the 2 quarters prior to bankruptcy. Comparing the results in Columns 5 and 6 with those in 7 and 8, we find that excluding the quarters before bankruptcy does not significantly affect the results, thus suggesting that the bankruptcy categorical variables are not endogenous in the regression on arrival delays. Finally, Columns 9 and 10 also drop the route–carrier fixed effect and the results are similar to those in Columns 7 and 8.

The estimated coefficient for $Log(Departed\ Flights_{jrt})$ shown in Columns 1 through 10 ranges from 1.04 to 1.09, implying that a 10% decrease in the number of performed arrivals decreases by approximately 10% the number of flights arriving at least 15 min late.

Canceled flights. Next, we focus on flight cancelations as a measure of air travel quality. In Table 5, the dependent variable for Eq. (1) is the natural logarithm of canceled flights by carrier j, in a market r, in a particular year quarter t. Again, note that in all of these regressions, we add $Log(Scheduled\ Flights_{jrt})$, the log of the number of scheduled flights by carrier j, in route r, during year–quarter t. The purpose of this control is to capture any effect that fewer flights by carrier j, in route r, at time t can have on the number of canceled flights by that carrier, in that route, at that time, and hence the effect of bankruptcy on cancelations is clean from any confounding effect that the downsizing which occurs during bankruptcy can have on flight cancelations.

Columns 1 and 2 show that during a carrier's bankruptcy, the insolvent firm drops the number of canceled flights by 8% relative to the number of cancelations pre-bankruptcy. After emerging from bankruptcy protection, cancelations by the previously insolvent carrier increase by 3% relative to pre-bankruptcy. The number of cancelations by the non-bankrupt carriers in competition with the bankrupt carrier falls by 4% while the insolvent firm operates under protection, but returns to the pre-bankruptcy level after the competitor emerges from protection. The positive effect of bankruptcy on the number of flight cancelations does not outlive the firm's bankruptcy, and both the insolvent firm and its competitors return to pre-bankruptcy levels or higher.

Results reported in Columns 3 and 4 are obtained excluding year–quarter fixed effects. The in-bankruptcy results are larger in magnitude but they are in the same direction for both the bankrupt and non-bankrupt firms (drop in cancelations); but the post-bankruptcy results are in the opposite direction (decrease in cancelations). Comparing the results in Columns 1 and 2 with those in 3 and 4 reveals that there are time-specific unobservable effects that, if uncontrolled, can confound the identification of the effect of bankruptcy on canceled flights.

Columns 5 and 6 further exclude the origin and destination time trends that capture any persistent correlation of cancelations over time within a market. The results are in the same direction as in Columns 3 and 4 but much larger in magnitude, suggesting that there are indeed origin and destination specific effects that are correlated over time and which can confound the effect of bankruptcy (e.g., an airport located in a city that is in persistent economic decline can become more inefficient, leading to a greater number of cancelations out of that origin airport, regardless of the carrier's bankruptcy status).

Columns 7 and 8 include the 2 quarters prior to bankruptcy. The results are marginally smaller in magnitude though in the same direction as in Columns 5 and 6. We therefore conclude that bankruptcy might not be endogenous to flight cancelations. Columns 9 and 10 further exclude route–carrier fixed effects, and we obtain similar results. Columns 11 and 12 also include random effects but now we run a tobit regression, allowing for left censoring at 0. Remarkably, the results are identical to those in Columns 9 and 10, suggesting that left censoring does not introduce a bias in our estimation.

We find that the coefficient on $Log(Scheduled\ Flights_{jrt})$ ranges from 0.89 to 0.92, suggesting that a 10% decline in flights is correlated with a 9% decline in cancelations.

Aircraft age. The age of the aircraft can impact the traveler's comfort (and possibly safety) during the flight. The bankrupt carrier's ability to selectively renege on aircraft leases while operating under bankruptcy court protection allows it to rescind leases on older, more inefficient, and uncomfortable airplanes in favor of newer, more efficient, and more comfortable ones. There is plenty of anecdotal evidence of bankrupt carrier's reneging their lease agreements on aircrafts. For instance, during US Airway's bankruptcy filing in 2002, a U.S. bankruptcy-court judge gave US Airways relief from making any payments on 57 aging jetliners it had parked in the desert after September 11.[26] During its 2004 bankruptcy filing, US Air agreed with General Electric Co. to defer lease payments on some aircrafts. The deal also called for GE Capital Aviation to lease 31 new 70- and 90-seat regional jets to the airline in the next 3 years and for the airline to return 25 of its larger older aircrafts .[27]

In Table 6, the dependent variable for Eq. (1) is the natural log of the maximum number of years since the aircraft's first delivery, $Log(Age\ Aircraft_{jrt})$.[28]

[26] See *The Wall Street Journal*, August 14, 2002.
[27] See *The Washington Post*, November 27, 2004.
[28] Only the 0.03 percent of the observations had an age of zero. To avoid dropping them we added a 1 to the age and then took the natural logarithm.

While in bankruptcy, the bankrupt carrier employs 'younger' planes: the maximum number of years since the aircraft's first delivery drops 9% relative to pre-bankruptcy (Column 1). The younger fleet remains active *even after the carrier emerges* from bankruptcy protection (Column 2). Non-bankrupt competitors cannot freely renege on their aircraft leases in order to substitute older for younger airplanes and we do not expect to see an improvement in aircraft age for these carriers. The results shown are consistent with this. The age of the aircraft fleet of the bankrupt carrier's competitors does not significantly change: it marginally increases by 2% while the bankrupt competitor operates under protection (Column 1) and returns to its pre-bankruptcy level once the carrier emerges from protection (Column 2).

As with the previous results, we find that excluding year–quarter fixed effects (Columns 3 and 4) significantly biases the results, making the effect of non-bankrupt carriers larger in magnitude and statistical significance (which would greatly increase the age of their fleet both during and after the carrier's bankruptcy).

The results in Columns 5 through 10 are similar in magnitude and in the same direction as those in Columns 3 and 4, suggesting that including the 2 quarters prior to bankruptcy (Columns 5 and 6), excluding origin and destination time trends (Columns 7 and 8), and excluding route–carrier fixed effects (Columns 9 and 10) can further confound the effects of bankruptcy.

The results we present here indicate that while product quality might improve during a bankruptcy filing, the effects do not persist after the firm emerges from bankruptcy. This is true measures of quality that result from daily operations of the firm (e.g., delays and cancelations). However, for changes in quality that stem from fixed investments (e.g., investment in aircrafts), the improvement in quality is persistent.

7. A note on other quality measures

There are other quality measures one can think of concerning airline services: baggage mishandled, oversold flights, customer complaints, and frequency of accidents and incidents. We collected this data.[29] Baggage data comes from the Aviation Consumer Protection office (filed with the Department of Transportation's Bureau of Transportation Statistics). Baggage statistics are on a monthly (or quarterly) basis, by U.S. carriers that have at least 1% of total domestic scheduled-service passenger revenues. Thus, these data are carrier–year–quarter–month specific, but not market specific. Since the data are not market specific, we lose an important degree of variation that allows us to precisely estimate the effect of bankruptcy on mishandled bags.

If we observe that during bankruptcy the number of mishandled bags per enplaned passenger drops, or increases, we cannot disentangle whether this stems from the bankruptcy filing, or from some year–quarter specific condition that disrupted baggage handling at the same time that bankruptcy was underway (for example, the shock of September 11).

However, we study these data and find that the mean number of mishandled baggages per enplaned passenger across carriers, markets, years is 0.0053 for the sample of 611 carrier–year–quarter observations for which there is a bankrupt carrier operating in the market and 0.0048 for the sample of 433 carrier–year–quarter observations corresponding to the post-bankruptcy period. The difference in means is not statistically significantly different from zero.

Another measure of airline quality that one might be tempted to use is the number of oversold seats: measured as the number of passengers who hold confirmed reservations and are (voluntary or involuntary) denied boarding because the flight is oversold. Again, the data on this measure are reported quarterly to the Bureau of Transportation Statistics, on a carrier–year–quarter basis. Thus, again, we lose the market dimensionality that allows us to identify the effect of bankruptcy on over-sales from confounding time specific effects. If we observe that over-sales increase during bankruptcy, we would not be able to identify whether this is a bankruptcy related effect or an effect related to a time specific boom/depression in demand booming for exogenous reasons.

Still, we study this data and find that the mean number of total passengers denied boarding for the set of 212 year–quarter–carrier observations for which no carrier is currently operating under bankruptcy is 0.0021, while the equivalent statistic for the set of 169 observations for which there is at least one carrier that operates under court protection, is 0.0015. The difference of means is statistically and economically insignificantly different from zero.

Customer complaints could also capture quality of service. We collect data on the total number of customer complaints, filed with the Department of Transportation in writing, by phone, via E-mail, or in person (it does not include safety complaints), who does not determine the validity of the complaints. The data are not systematically gathered across markets, years and carriers. We therefore consider it too noisy to make any significant statistical inferences.

Finally, from the National Transportation Safety Board, we collected data on accidents and incidents by carrier, on a year–quarter–market basis, from 1993 until 2006. We have detailed data on the causes of accidents and incidents, and on the carrier's response to these events.[30] Fortunately, there are too few accidents and incidents per carrier, year–quarter, and market unit of observation that no significant conclusions can be drawn. For example, between 1993 and 2006, there are 18 fatal, and 275 non-fatal, accidents across all markets and across all airlines. Given the large number of markets and flights serving these markets over this 13 year time window, a total of 293 accidents is statistically negligible. Over the same sample period, and across all

[29] Summary statistics as well as regression analysis using baggage mishandled, oversales, accidents, and customer complaints is available from the authors upon request.

[30] The National Transportation Safety Board defines accidents as an occurrence associated with the operation of an aircraft where as a result of the operation of an aircraft, any person (either inside or outside the aircraft) receives fatal or serious injury or any aircraft receives substantial damage. And it defines incidents as occurrences, other than an accident, associated with the operation of an aircraft that affects or could affect the safety of operations.

markets and flights, there have been 275 incidents. Again, a fraction too small relative to the total number of markets and flights draw significant inferences.[31]

8. Conclusions

With the tightening of available credit following the Panic of 2007, several industries have faced cash constraints that pushed firms into insolvency. This reignited the debate on the effect that bankruptcy has on different economic agents, one of them being the firm's consumers. What effect would a firm's bankruptcy have on the quality of the products that the bankrupt firm offers?

In this paper we use objective ways to define measures of product quality for airline service: flight cancelations, flight delays, and aircraft age. We find that delays and cancelations are less frequent during bankruptcy filings but return to their pre-bankruptcy levels once the bankrupt firm emerges from Chapter 11. We also find that firms use Chapter 11 filings to permanently reduce the average age of their fleet. We do not find evidence of statistically and economically significant changes by the airline's competitors along any of the dimensions above. There are other measures of product quality, such as mishandled bags, oversold seats, customer complaints, and accident and incident rates, but these are either not market specific, or there are too few observations to make significant statistical (and economic) inferences.

Our work sheds light on the effect of bankruptcy filings in other industries. For example, General Motors (GM) recently filed for Chapter 11 bankruptcy. Under bankruptcy, GM shed brands such as Pontiac, Saab, and Saturn. Hence, consumers now have fewer choices. Yet, it might be that GM will increase the quality of the brands it still produces (e.g., more reliable and comfortable). Another example: Kmart's Chapter 11 bankruptcy (January 22, 2002). While restructuring, Kmart closed more than 300 stores in the U.S. and laid off about 34,000 workers. At the same time it introduced five prototype stores. These stores were advertised as having wider aisles, improved selection, and better lighting. Kmart moved towards fewer stores but better quality ones. Our analysis shows that customers should be cautious about any effective improvement of product quality: neither GM nor Kmart are likely to improve the quality of the products that they continue to produce. However, because of the downsizing associated with the bankruptcy filing, GM and Kmart might shed their worse quality products.

This paper also complements the work of Ciliberto and Schenone (2012) who show a reduction in the variety of products the bankrupt firm offers while in bankruptcy and after emerging from bankruptcy. Customers have less options to choose from and hence the distance from their preferred choice and the actual available options might increase. This shift in business strategy is detrimental to consumers. Here we show a further dimension along which customers are not better off during or after a bankruptcy filing: for the products that the firm continues to offer, quality does not improve, but rather worsens or remains at pre-bankruptcy levels. The only significant improvement we document is the one stemming from changes that relate to investments in durable fixed assets.

References

Ashenfelter, Orley, 1978. Estimating the effect of training programs on earnings. Rev. Econ. Stat. 60 (1), 47–57.
Bebchuk, Lucian A., 2002. Ex ante costs of violating absolute priority in bankruptcy. J. Finance 57, 445–460.
Benoît, Jean-Pierre, 1985. Financially constrained entry in a game with incomplete information, Rand. J. Econ. 490–499, (1986–1985).
Berry, Steven, 1990. Airport presence as product differentiation. Am. Econ. Rev. Pap. Proc. 80 (2), 394–399.
Berry, Steven, Jia, P., 2010. Tracing the woes: an empirical analysis of the airline industry. Am. Econ. J. Microecon. 2 (3), 1–43.
Bhagat, Sanjai, Moyen, Nathalie, Suh, Inchul, 2005. Investment and internal funds of distressed firms. J. Corp. Finance 11 (3), 449–472.
Borenstein, Severin., 1989. Hubs and high fares: dominance and market power in the U.S. airline industry, Rand. J. Econ. 20 (3), (Autumn), 344–365.
Borenstein, Severin., Rose, Nancy., 2003. The impact of bankruptcy on airline service levels. Am. Econ. Rev. Proc. 93 (2) (May), 415–419.
Bowen, Brent D., Dean, Headley E., 1997. Airline Quality Rating. W. Frank Barton, School of Business, Wichita, Kansas.
Brander, J., Lewis, T., 1986. Oligopoly and financial structure: the limited liability effect. Am. Econ. Rev. 76 (5), 956–970.
Bris, Arturo, Welch, Ivo, Zhu, Ning, 2006. The costs of bankruptcy. J. Finance 61, 1253–1303.
Brueckner, Jan K., Dyer, Nichola J., Spiller, Pablo T., 1992. Fare determination in airline hub-and-spoke networks. RAND J. Econ. 23 (3), 309–333.
Campello, Murillo, 2003. Capital structure and product markets interactions: evidence from business cycles. J. Financ. Econ. 68 (3), 353–378.
Campello, Murillo, 2006. Debt financing: does it boost or hurt performance in product markets? J. Financ. Econ. 83, 135–172.
Carapeto, Maria, 2005. Bankruptcy bargaining with outside options and strategic delay. J. Corp. Finance 11 (4), 736–746.
Chevalier, Judith, 1995a. Do LBO Supermarkets charge more? An empirical analysis of the effects of LBO on supermarket pricing. J. Finance 50, 1095–1112.
Chevalier, Judith, 1995b. Capital structure and product–market competition: empirical evidence from the supermarket industry. Am. Econ. Rev. 85, 415–435.
Chevalier, Judith, Scharfstein, David, 1995. Liquidity constraints and the cyclical behavior of markups. Am. Econ. Rev. 85, 390–396.
Ciliberto, F., Schenone, C., 2012. Bankruptcy and product-market competition: evidence from the airline industry. Inter. J. Ind. Org. 30, 564–577.
Dasgupta, Sudipto, Titman, Sheridan, 1998. Pricing strategy and financial policy. Rev. Financ. Stud. 11, 705–737.
Eckbo, Espen, Throburn, Karin, 2009. Creditor financing and overbidding in bankruptcy auctions: theory and tests. J. Corp. Finance 15 (1), 10–29.
Elliott, K.M., Roach, D.W., 1993. Service quality in the airline industry: are carriers getting an unbiased evaluation from consumers? J. Prof. Serv. Mark. 9, 71–82.
Ferris, Stephen, Jayaraman, Narayanan, Makhija, Anil, 1997. The response of competitors to announcements of bankruptcy: an empirical examination of contagion and competitive effects. J. Corp. Finance 3 (4), 367–395.
Franks, Julien R., Torous, Walter N., 1989. An empirical investigation of U.S. firms in reorganization. J. Finance 44.
Friedberg, Leora, 1998. Did unilateral divorce raise divorce rates? Evidence from panel data. Am. Econ. Rev. 88 (3), 608–627.
Gerardi, Kristopher S., Adam, Hale Shapiro, 2009. Does competition reduce price dispersion? New evidence from the airline industry, J .Polit. Econ. University of Chicago Press 117 (1), 1–37.
Gourdin, Kent N., 1988. Bringing quality back to commercial air travel. Transp. J. 27 (3), (Spring) 23–29.
Halvorsen, R., Palmquist, R., 1980. The interpretation of dummy variables in semilogarithmic equations. Am. Econ. Rev. 70, 474–500.
Hennesy, C.A., Whited, T.M., 2007. How costly is external financing? Evidence from a structural estimation. J. Finance. 62, 1705–1745.

[31] Note that of the total number of 540 accidents and incidents, 9 have been at the airport and airport-related.

Holmes, George M., Rupp, Nicholas, 2006. An investigation into the determinants of flight cancellations. Economica 73, 749–784.
Hotchkiss, Edith S., 1995. Postbankruptcy performance and management turnover. J. Finance 50, 3–21.
Hotchkiss, Edith, Mooradian, Robert, 2003. Auctions in bankruptcy. J. Corp. Finance 9 (5), 555–574.
John, Kose, Lang, Larry H.P., Netter, Jeffry, 1992. The voluntary restructuring of firms in response to performance decline. J. Finance 47 (3), 891–917.
Kovenock, Dan., Phillips, Gourdin, 1995. Capital Structure and Product-Market Rivalry: How Do We Reconcile Theory and Evidence? American Economic Review. American Economic Association 85 (2), (May) 403–408.
Kovenock, Dan., Phillips, Gourdin, 1997. Capital Structure and Product Market Behaviour: An Examination of Plant Exit and Investment Decisions. Review of Financial Studies 10 (3), (Autumn) 767–803.
Maksimovic, V., 1988. Capital structure in a repeated oligopoly. Rand J. Econ. 389–407.
Maksimovic, V., Titman, S., 1991. Financial policy and reputation for product quality. Rev. of Financial Stud. 175–201.
Mayer, Christopher, Todd, Sinai, 2003. Network effects, congestion externalities, and air traffic delays: or why not all delays are evil. Am. Econ. Rev. 93 (4), 1194–1215.
Mazzeo, Michael, 2003. Competition and service quality in the US airline industry. Rev. Ind. Organ. 22, 275–296.
Opler, Tim, Titman, Sheridan, 1994. Financial distress and corporate performance. J. Finance 49, 1015–1040.
Phillips, Gordon, 1995. Increased debt and industry product markets: an empirical analysis. J. Financial Econ. 37, 189–238.
Pichler, Pegeret, Stomper, Alex, Zulehner, Christine, 2008. Why leverage affects pricing. Rev. Financ. Stud. 21 (4), 1733–1765.
Ramdas, Kamalini, Williams, Jonathan, 2011. An Empirical Investigation into the Tradeoffs that Impact On-time Performance in the Airline Industry. University of Virginia. Working Paper.
Rupp, Nicholas, Owens, D., Plumly, L., 2006. Does competition influence airline on-time performance. In: Lee, Darin (Ed.), Advances in Airline Economics: Competition Policy and Antitrust. Elsevier B.V.
Thorburn, Karin S., 2000. Bankruptcy auctions: costs, debt recovery and firm survival. J. Financ. Econ. 40, 337–368.
Tirole, Jean, 1988. The Theory of Industrial Organization. MIT Press.
Titman, Sheridan, 1984. The effect of capital structure on a firm's liquidation decision. J. Financial Econ., Elsevier 13 (1), 137–151 (March).
Veerbek, M., Nijman, T., 1992. Testing for selectivity bias in panel data models. Int. Econ. Rev. 33 (3), 681–703.